

# TABLE OF EQUATIONS

$S(i) = \left\{ \frac{\partial Y_{i,j}}{\partial \Phi_{i,j}} \right\}$	(5)
$\frac{ \Delta\phi(i) ^2}{ \phi(i) ^2} < \text{desired accuracy}$	(9)
$\frac{1}{r} \left( r \frac{\delta v}{\delta r} \right) + 2ik \frac{\delta v}{\delta z} = 0$	(10)
$h(x,y) = \frac{e^{jk\Delta z}}{j\lambda\Delta z} \exp \left[ \frac{jk}{2\Delta z} (x^2 + y^2) \right]$	(12)
$H(f_x, f_y) = e^{jk\Delta z} \exp [-j\pi\lambda\Delta z (f_x^2 + f_y^2)]$	(13)
$U(x,y,z+\Delta z) = \mathcal{F}^{-1} \{ \mathcal{F}U(x,y,z)H(k_x,k_y) \}$	(14)
$H = \begin{bmatrix} \exp\{\phi_{1,1}(i)\} & 0 & 0 & 0 \\ 0 & \exp\{\phi_{1,2}(i)\} & 0 & 0 \\ 0 & 0 & \exp\{\phi_{2,1}(i)\} & 0 \\ 0 & 0 & 0 & \exp\{\phi_{2,2}(i)\} \end{bmatrix}$	(15)
$\begin{bmatrix} U_0 \\ U_1 \\ U_2 \\ U_3 \end{bmatrix} = dx \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & W & W^2 & W^3 \\ 1 & W^2 & W^4 & W^6 \\ 1 & W^3 & W^6 & W^9 \end{bmatrix} \begin{bmatrix} u_0 \\ u_1 \\ u_2 \\ u_3 \end{bmatrix}$	(16)
$\begin{bmatrix} u_0 \\ u_1 \\ u_2 \\ u_3 \end{bmatrix} = dfx \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & W^{-1} & W^{-2} & W^{-3} \\ 1 & W^{-2} & W^{-4} & W^{-6} \\ 1 & W^{-3} & W^{-6} & W^{-9} \end{bmatrix} \begin{bmatrix} U_0 \\ U_1 \\ U_2 \\ U_3 \end{bmatrix}$	(18)

## Appendix A

The first element of an  $8 \times 8$  sensitivity matrix, for two four long 1-D phase screens, is shown for illustrative purposes and to provide a reference for anyone else attempting this approach.  $p_{11}, p_{12}, p_{13}, p_{14}, p_{21}, p_{22}, p_{23}, p_{24}$  represent the phase elements for the two phase screens.

```
> element11:=evalf(sens2[1,1],3);element11 :=  
> (-.418e6-.721e6*I)*((.883e-8-.612e-7*I)*p21-(.265e-7+.306e-7*I)*p22+(.  
> 265e-7+.306e-7*I)*p23-(.265e-7+.306e-7*I)*p24)+(.833e6-753.*I)*((- .612  
> e-7-.883e-8*I)*p21+(-.290e-8+.404e-7*I)*p22-(.265e-7+.306e-7*I)*p23+(.  
> 404e-7+.290e-8*I)*p24)-(.417e6+.722e6*I)*((- .883e-8+.612e-7*I)*p21+(.3  
> 06e-7-.265e-7*I)*p22+(.265e-7+.306e-7*I)*p23+(-.306e-7+.265e-7*I)*p24)  
> -(.417e6+.722e6*I)*((.612e-7+.883e-8*I)*p21-(.404e-7+.290e-8*I)*p22-(.  
> 265e-7+.306e-7*I)*p23+(-.290e-8-.404e-7*I)*p24)+(.833e6+0.*I)*((.883e-8  
> -.612e-7*I)*p21+(.265e-7+.306e-7*I)*p22+(.265e-7+.306e-7*I)*p23+(.265e  
> -7+.306e-7*I)*p24)-(.417e6+.722e6*I)*((- .612e-7-.883e-8*I)*p21+(-.290e-  
> 8-.404e-7*I)*p22-(.265e-7+.306e-7*I)*p23-(.404e-7+.290e-8*I)*p24)-(.41  
> 7e6+.722e6*I)*((- .883e-8+.612e-7*I)*p21+(-.306e-7+.265e-7*I)*p22+(.265  
> e-7+.306e-7*I)*p23+(-.306e-7-.265e-7*I)*p24)+(.833e6-753.*I)*((- .612e-7+  
> .883e-8*I)*p21+(-.404e-7+.290e-8*I)*p22-(.265e-7+.306e-7*I)*p23+(-.290e  
> -8+.404e-7*I)*p24)
```